

WHAT IS CLAIMED IS:

1                    1.        A method of filling a gap defined by adjacent raised features on a  
2        substrate, comprising:  
3                    providing a flow of a silicon-containing processing gas to a chamber housing  
4        the substrate;  
5                    providing a flow of an oxidizing gas to the chamber;  
6                    depositing a first portion of a film as a substantially conformal layer in the gap  
7        by causing a reaction between the silicon-containing processing gas and the oxidizing gas,  
8        wherein depositing the conformal layer comprises varying over time a ratio of the (silicon-  
9        containing processing gas):(oxidizing gas) and regulating the chamber to a pressure in a  
10       range from about 200 torr to about 760 torr throughout deposition of the conformal layer;  
11                   thereafter, depositing a second portion of the film as a bulk layer, wherein  
12       depositing a second portion of the film comprises maintaining the ratio of the (silicon-  
13       containing processing gas):(oxidizing gas) substantially constant throughout deposition of the  
14       bulk layer and regulating the chamber to a pressure in a range from about 200 torr to about  
15       760 torr throughout deposition of the bulk layer; and  
16                   thereafter, exposing the substrate to nitrous oxide at a temperature less than  
17       about 900°C to anneal the deposited film.

1                    2.        The method of claim 1, wherein exposing the substrate to nitrous oxide  
2        at a temperature less than about 900°C to anneal the deposited film comprises exposing the  
3        substrate to nitrous oxide at a temperature less than about 750°C to anneal the deposited film.

1                    3.        The method of claim 1, further comprising thereafter planarizing the  
2        film.

1                    4.        The method of claim 3, wherein planarizing the film comprises  
2        subjecting the film to chemical mechanical polishing.

1                    5.        A method of forming isolation structures in a silicon substrate,  
2        comprising:  
3                    etching trenches in the substrate;  
4                    providing a flow of a silicon-containing processing gas to a chamber housing  
5        the substrate;  
6                    providing a flow of an oxidizing gas to the chamber;

7 causing a reaction between the silicon-containing processing gas and the  
8 oxidizing processing gas to form a silicon oxide layer;  
9 heating the substrate in the presence of nitrous oxide; and  
10 thereafter, planarizing the layer.

1 6. The method of claim 5, wherein planarizing the layer comprises  
2 subjecting the layer to chemical mechanical polishing.

1 7. The method of claim 5, wherein causing a reaction between the silicon-  
2 containing processing gas and the oxidizing processing gas to form a silicon oxide layer  
3 comprises:

4 depositing a first portion of a film as a substantially conformal layer in the  
5 trenches by causing a reaction between the silicon-containing processing gas and the  
6 oxidizing gas, wherein depositing the conformal layer comprises varying over time a ratio of  
7 the (silicon-containing processing gas):(oxidizing gas) and regulating the chamber to a  
8 pressure in a range from about 200 torr to about 760 torr throughout deposition of the  
9 conformal layer; and

10 thereafter, depositing a second portion of the film as a bulk layer, wherein  
11 depositing a second portion of the film comprises maintaining the ratio of the (silicon-  
12 containing processing gas):(oxidizing gas) substantially constant throughout deposition of the  
13 bulk layer and regulating the chamber to a pressure in a range from about 200 torr to about  
14 760 torr throughout deposition of the bulk layer.

1 8. The method of claim 7, wherein heating the substrate in the presence  
2 of nitrous oxide comprises exposing the substrate to nitrous oxide at a temperature less than  
3 about 900°C to anneal the deposited film.

1 9. A method of forming a silicon oxide layer on a substrate, comprising:  
2 providing a flow of a silicon-containing processing gas to a chamber housing  
3 the substrate;  
4 providing a flow of an oxidizing processing gas to the chamber;  
5 causing a reaction between the silicon-containing processing gas and the  
6 oxidizing processing gas to form a silicon oxide layer; and  
7 heating the substrate in the presence of nitrous oxide.

1 10. The method of claim 9, wherein:

2 providing a flow of a silicon-containing processing gas comprises providing a  
3 flow of tetraethylorthosilicate (TEOS); and  
4 providing a flow of an oxidizing processing gas comprises providing a flow of  
5 ozone.

1 11. The method of claim 9, wherein causing a reaction between the silicon-  
2 containing processing gas and the oxidizing processing gas comprises regulating the pressure  
3 of the chamber to sub-atmospheric levels.

1 12. The method of claim 11, wherein the sub-atmospheric levels comprise  
2 pressures in a range from about 200 torr to less than about 760 torr.

1 13. The method of claim 9, wherein causing a reaction between the silicon-  
2 containing processing gas and the oxidizing processing gas comprises regulating the  
3 temperature of the chamber to a range from about 400° C to about 570° C.

1 14. The method of claim 9, wherein heating the substrate in the presence  
2 of nitrous oxide comprises heating the substrate to a temperature in a range from about 750°  
3 C to about 1000° C in a furnace.

1 15. The method of claim 15, wherein heating the substrate in the presence  
2 of nitrous oxide further comprises introducing steam into the furnace.

1 16. The method of claim 9, wherein heating the substrate in the presence  
2 of nitrous oxide comprises heating the substrate to a temperature greater than or equal to  
3 1000° C in a rapid thermal process for a duration greater than or equal to 1 minute.

1 17. A method of forming a silicon oxide layer on a substrate, comprising:  
2 providing a flow of a silicon-containing processing gas to a chamber housing  
3 the substrate;  
4 providing a flow of ozone to the chamber;  
5 causing a reaction between the silicon-containing processing gas and the  
6 ozone to form a silicon oxide layer; and  
7 heating the substrate in the presence of nitrous oxide in a furnace to a  
8 temperature in the range from about 750° C to about 1000° C.

1                    18.     The method of claim 17, further comprising introducing steam into the  
2     furnace.

1                    19.     The method of claim 17, wherein the silicon-containing processing gas  
2     comprises tetraethylorthosilicate (TEOS).

1                    20.     A method of forming a silicon oxide layer on a substrate, comprising:  
2                    providing a flow of tetraethylorthosilicate (TEOS) processing gas to a  
3     chamber housing the substrate;  
4                    providing a flow of ozone to the chamber;  
5                    regulating the pressure of the chamber to a pressure in a range from about 200  
6     torr to less than about 760 torr;  
7                    causing a reaction between the TEOS and the ozone to form a silicon oxide  
8     layer; and  
9                    heating the substrate in the presence of nitrous oxide.

1                    21.     The method of claim 20, wherein heating the substrate in the presence  
2     of nitrous oxide comprises heating the substrate in the presence of nitrous oxide in a furnace  
3     to a temperature in the range from about 750° C to about 1000° C.

1                    22.     The method of claim 20, wherein heating the substrate in the presence  
2     of nitrous oxide comprises heating the substrate to a temperature greater than or equal to  
3     1000° C in a rapid thermal process for a duration greater than or equal to 1 minute.

1                    23.     A method of forming a silicon oxide layer on a substrate, comprising:  
2                    providing a flow of tetraethylorthosilicate (TEOS) processing gas to a  
3     chamber housing the substrate;  
4                    providing a flow of ozone to the chamber;  
5                    regulating the pressure of the chamber to a pressure in the range from about  
6     200 torr to less than about 760 torr;  
7                    causing a reaction between the TEOS and the ozone to form a silicon oxide  
8     layer; and  
9                    heating the substrate in the presence of nitrous oxide in a furnace to a  
10     temperature in the range from about 750° C to about 1000° C.